ANNUAL REPORT

LAKE STATES FOREST EXPERIMENT STATION
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

E. L. DEMMON, DIRECTOR

1946

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Lake States Forest Experiment Station

ANNUAL REPORT FOR 1946

As 1946 closed, the war emergency ended, according to presidential proclamation. The "shooting war" had ceased in 1945; during 1946, many wartime restrictions were lifted and industry had largely converted to making peacetime products. But for American forests the emergency was far from over. The tremendous war demand for forest products was more than taken over by the needs of peace. Wood was needed to build new homes for veterans, for business and industrial construction, for farm buildings, for maintenance and repair work, for manufacturing numerous products, for boxes and crates, for stock replacements in lumber yards, and small amounts for export. Pulp and paper supplies also were short, particularly newsprint. The United States imports about a third of the pulp and paper it uses.

During 1946, United States lumber requirements exceeded 37 billion board feet - over 2 billion more than were produced. And in 1947, it is estimated that even more will be needed. Our forests have been overcut heavily the last few years, and this pressure will no doubt continue. Yet, if forest cutting is not guided along the lines of good forestry practice, the damage will be felt for generations to come. Good forestry practice must be based on sound principles, which are best determined through organized forest research.

Held in check during the war, forest research received new impetus during 1946. A resurgence of interest in the condition of our forest resources - strained by severe wartime demands - manifested itself by congressional action leading to the establishment of several new federal forest research centers throughout the Nation. Included were research centers for northern Minnesota and northern Wisconsin, under the direction of the Lake States Forest Experiment Station.

Funds became available July 1, 1946, and by the end of the year these forest research centers were "going concerns." Their areas of work were delineated, headquarters selected, competent personnel on the job, advisory councils selected and meetings held: problems needing study were analyzed and assigned priorities, and certain experimental forests were set up. The previous program of the Station is correlated closely with the new research center work.

The Station's responsibility for carrying the Federal Government's share of forestry investigations in 1946 included such activities as these:

1. A new county-by-county survey of the forest resources of the Lake States was launched just 10 years after the original field survey was completed.

2. Forest-fire occurrence in Indiana and Missouri was studied at the request of the Forest Service and state foresters.

3. The advantages to Upper Michigan farmers in logging their second-growth hardwood lands was demonstrated by the first cutting of a sample "farm forestry" area.

4. The possibilities of thinning young aspen and the best season to cut older stands, either to retard or to stimulate sprouting, were reported.

5. Possible profit from planting was illustrated by analysis of a 30-year-old red pine plantation.

6. The significance of seed source was indicated by growth studies on plantations of red pine, Scotch pine, ponderosa pine, and several spruces.

7. The effect of windbreaks on temperature conditions and moisture conservation was described.

8. Farm forestry studies developed improved equipment for small sawmills, recommendations for handling mixed-oak woodlands, and a simple but effective new method for preserving fence posts.

9. Additional facts on forest-wildlife relationships as a basis for multi-purpose land use management were reported.

Although considerable progress was made during 1946, many regional research problems are still unsolved. Their solution can be furthered best by more forest research center activities, the establishment of a forest utilization service, and the completion of the resurvey of forest resources of the Lake States. The work of the Station during 1946 is reviewed briefly in the following pages.

ESTABLISHMENT OF NEW FOREST RESEARCH CENTERS

To carry on forestry studies most effectively and to make them of maximum value to local industries and timberland owners, local research units are needed for each section having distinct forestry problems. Toward this end, major efforts of the Station during 1946 were devoted to establishing t· forest research centers and strengthening the program on another experimental area.

The purpose of forest research centers is to carry out research in forest management in its broadest sense as applied to local conditions. It includes studies of silviculture, reforestation, timber harvest and regeneration, and the economics of timber growing and marketing. It may include local research in fire protection. It does not include the Forest Survey, general land and economic studies, nor forest products investigations; nevertheless, these latter fields of study directly influence forest management and the program of work contemplated.

Northern Wisconsin Center

The northern Wisconsin center embraces the extensive lake area in the northern part of the state and most of the central sand plains. It

includes 10 million of the 17 million acres of forest land in the state. In this territory probably three-fourths or more of the entire land area is best suited to forest growth.

The forests of northern Wisconsin have been depleted perhaps more than those of Minnesota or Upper Michigan. The high degree of accessibility and concentration of utilization plants have contributed to the depletion. On the other hand, these same plants offer excellent opportunities for intensive forestry practice.

Since the center was established on July 1, a staff, consisting of a leader, three additional technically trained men, and a clerk, has been recruited. Offices have been set up at Rhinelander in the headquarters of the Forest Supervisor of the Nicolet National Forest. Problems needing study have been analyzed and evaluated to determine priorities. To obtain the benefit of the advice of other technical foresters in the area, an advisory council including representatives from industry, agricultural extension, county, state, and national forests, was organized. The consideration of research problems at the first meeting indicated the need for a balanced research program concerned with the management of aspen, pine, spruce-fir, and second-growth northern hardwoods forest types and with studies of plantation care and establishment.

Progress has been made in the selection of experimental forests in the balsam fir-aspen and second-growth hardwoods types within a few miles of Rhinelander on the Nicolet National Forest. Since the major part of the work will be conducted on experimental forests, the facilities available will govern the first work undertaken. Recommendations for formal setting aside of these areas for research will be made shortly so that an active research and demonstration program can get under way. Efforts will be made to find suitable areas representative of all major forest types.

Northern Minnesota Center

The Northern Minnesota Research Center serves an area of about 18½ million acres, embracing a portion of the headwater basins of three important rivers - the Mississippi, the St. Lawrence, and the Red River of the North (Hudson Bay drainage). Over 72 percent of this region is in commercial forest, 9 percent is nonproductive or forest land withdrawn from timber use (parks, etc.), about 8 percent is in other uses (urban, roads, etc.), and less than 10 percent is cleared farm land. The research center area includes diverse soils and topography typical of glaciated country. The forests, although mostly cutover, in places support good stands of jack pine, spruce, and aspen.

A research center leader and three other technical men, a timber sales assistant, and a clerk comprise the staff. Headquarters have been set up at Grand Rapids, Minnesota. Unlike Wisconsin, forest management research on a small scale has been under way for some time in northern Minnesota. The Pike Bay (aspen), the Cut Foot (red pine-jack pine), and the Kawishiwi (jack pine-black spruce) Experimental Forests have been established and operating on a small scale for a number of years.

The establishment of the center presented an opportunity to review past work and to reorient it along new lines, as well as to consider other problems in need of attention. An advisory council meeting attended by foresters representing private and public agencies recommended that management of black spruce, aspen, balsam-fir-spruce, and jack pine types be given first priority. Management studies in red pine, tamarack, and white pine, and investigations in reforestation were given second priority, whereas management of mixed hardwoods was given lowest priority.

In view of the high importance given to spruce studies, there is need for additional experimental areas in the black spruce and balsam-spruce forest types. Efforts are now being made to locate such areas.

Upper Peninsula Experimental Forest

Studies have been under way on the Upper Peninsula Experimental Forest near Marquette, Michigan, for several years. A small increase in funds July 1, 1946, permitted the addition of one more man to the staff. There are now two technical men assigned to this area, along with a timber sales assistant.

The Upper Peninsula is 88 percent forested, comprising over 9 million acres of forest land. It contains the largest area and volume of old-growth forest remaining in the Lake States, including about 1 million acres of the northern hardwood-hemlock type. Studies at the Upper Peninsula Station since 1926 have dealt almost exclusively with methods of cutting in old-growth hardwood stands. With the addition of another technical man, work is being extended to second-growth northern hardwoods. The current market for cordwood in the locality of this experimental forest is good, and the expansion of work in this type is reported later under management studies.

Additional experimental forests are needed to work out optimum forest management practices for the 1 million acres of swamp forest, 1 million acres of spruce-fir forest, 2 million acres of aspen, and the 1 1/3 million acres of cutover, barren, or deteriorating forest land in Upper Michigan. Not only timber production, but also wildlife and recreational values must be coordinated in the management of these lands.

To round out an adequate forest research program in the Lake States, the work in the Upper Peninsula of Michigan should be strengthened and research centers should be established in Lower Michigan, southern Wisconsin, and southern Minnesota.

FOREST ECONOMICS ACTIVITIES

Forest Survey Renewed

The forest resources of the Lake States were first inventoried by a field survey completed in 1936. A reappraisal of the situation two years ago pointed up the need for a new field survey. This new survey

was begun in 1946 on a county-by-county basis, in cooperation with the State Departments of Conservation and other interested agencies.

In Michigan, the first county selected for experimental work was Marquette in the Upper Peninsula. A field crew of four to six men recruited from the Station, the Department of Conservation, Michigan State College, and the Regional Office of the Forest Service conducted field work from August to November 1946. A report is now in preparation.

A second undertaking in Michigan is the Eaton, Ingham, and Clinton county block in the Lower Peninsula, adjacent to Lansing. This is to be completed by April 1947, after which the crew will return to work another county in the Upper Peninsula.

In Minnesota, a Forest Survey Committee made up of men from the U.S. Forest Service, Minnesota Forest Service, Iron Range Resources and Rehabilitation Commission, northern Minnesota counties, and forest industries is assembling all available forest resources information, following which a resurvey program is to be initiated. Field crews have started in Koochiching and Aitkin Counties to map some 500,000 acres of commercial forest land, using aerial photographs and modern techniques.

The first survey job in Wisconsin will be Marinette County where the county itself has obtained new aerial photographs of its forest land.

The new survey program, which is expected to take about 10 years to complete, will include not only a thorough study of available timber resources but will also provide an annual compilation of forest drain - the cutting for various products and the losses from fire, insects, and disease. It will deal also with forest growth and allowable cut. Lands in different ownerships will be considered separately. Reports on a county-by-county basis will be issued currently as the job progresses.

Forest Economics

Studies in general forest economics - held in abeyance during the war - were renewed on a small scale in 1946. Following a new job analysis, four principal projects are under consideration:

1. Problems of public forest land ownership. These deal with such matters as the financial contributions which federal lands make in lieu of taxes, how public lands can stabilize community life in forested districts, how tax-forfeited land might be organized into county or state conservation projects, and problems of local financing growing out of extensive land forfeiture.

2. Problems of private commercial forest land ownership. Studies of opportunities for timberland ownership by industrial companies, the effect of land valuation and taxing policies on private forest management, and other economic obstacles to private forestry in this region.

3. Forest-farming communities and the economic aspects of farm forestry. Such studies in the cutover region and the southern farming districts of the Lake States have received considerable attention in the past from the Lake States Station and by workers from the State Agricultural Experiment Stations, the Bureau of Agricultural Economics, and others. We are proposing to renew efforts and encourage work by the other agencies on a coordinated basis.

4. The economic aspects of forest management. Such studies will be handled primarily from the newly established forest research centers. Many of the currently pressing problems of forest management are economic rather than silvicultural in nature. There is uncertainty, for example, whether pine timber should be grown for pulpwood or sawlogs, or both. The decision rests, to a considerable extent, upon the carrying costs over various rotations and to some extent, of course, upon the timber requirements situation of this region. The question of whether aspen land should be kept in aspen or converted to other species is largely economic, depending upon costs of conversion, annual maintenance charges, and the value of the competitive crops. A choice between different cutting methods in spruce will be based partly on silvicultural considerations and partly on economic. What is needed is detailed and accurate information on costs of operations both with the conventional operating methods and with new equipment and improved techniques. Along this line, the Station recently issued a paper on "The Future of Aspen in the Lake States" and a series of articles dealing with the problems of different forest industries.

FOREST MANAGEMENT FINDINGS

Forest Fire Research

Since organized fire control was started in the Lake States some 30 years ago, the mean annual burn has been reduced more than 10 times - from 2 to less than 0.2 percent of the area protected. This has been due primarily to two things: (1) more adequate fire control, and (2) less serious fire danger resulting from reduced number and size of slashings and land-clearing operations.

Credit for this progress must go primarily to nature and to those directly responsible for fire control, but research, too, has contributed materially to the effectiveness of fire control effort. It has (1) supplied needed basic information on fire occurrence, behavior, damage and methods of control, (2) classified fuels as to rate of spread and resistance to control, (3) determined the conditions under which fires occur and get out of hand, (4) developed methods for measuring burning conditions and anticipating fire danger, (5) determined the strength of attack called for under given conditions, (6) appraised damage, and (7) analyzed the results of protection effort.

During 1946, fire research was limited to a study of fire occurrence in the Central States, made at the request of the Regional Office of the Forest Service and the respective state foresters. A report on "Forest Fires in Indiana" was completed for publication and one for

Missouri - to be completed by the Regional Office Division of State and Private Forestry - was started. Work interrupted by the war was resumed on a study of the effect of cover on burning conditions.

Fire control in the Lake States has largely emerged from the development stage. The chief need now is to consolidate the gains and increase efficiency. This calls for improved techniques which require precise information. The compilation and analysis of data which heretofore have been largely handled by Research can well be taken over by the administrative organization.

At the present time the outstanding need in the field of fire research in the Lake States is a thorough-going analysis of 10 years' accumulation of fire and fire-weather data as a basis for a more precise appraisal of Hazard or fuel conditions and Inflammability or burning conditions. There is also urgent need for a study of Risk or the chance of fires starting, to determine its importance as a factor of fire danger and how it can best be evaluated.

Management of Aspen

Until recently the management of aspen has received little attention because of its low value and plentiful supply. Following the exploitation of the old-growth white pine and hardwood forests, aspen spread to all kinds of soils except the wettest swamps. It now occupies more than 20 million acres in the Lake States Region. Because it grows on such a wide range of sites, aspen poses many questions of management.

Aspen grows faster and to larger size on the better soils. Accordingly, thinnings should have the best chances of paying out on good sites. This is illustrated by experimental thinnings made in 1936 in a dense 13-year-old aspen stand on a good site. The unthinned area contained about 3,600 stems per acre (equal to 3x4-foot spacing). Spacings in thinned plots varied from 5x5 feet to 10x11 feet. In 1945, at age 23, these stands had grown into merchantable pulpwood size as shown below.

Spacing	1936 (age 13) Trees 1/ per acre after thinning	1945 (age 23) Trees per acre	Cords 2/
Feet	Number	Number	
Check	3,633	1,333	7.4
5x5	1,717	1,383	10.5
6x6	1,217	1,075	12.8
7x7	975	933	15.9
8x9	545	512	17.5
10x11	396	359	11.4

1/ No trees had reached cordwood size.
2/ To a 3-inch top inside bark.

The trees on these plots responded exceptionally well to thinning. The volume gained by thinning to the 7x7-foot and 8x9-foot spacings was sufficient to pay for the first thinning in which nothing of commercial value was obtained.

On the poorer sites where aspen does not grow well, replacement by conifers has been suggested. Yet even in sandy soils aspen suckers shoot up to interfere with planted jack and red pine. That release from these suckers can be accomplished effectively is shown by a test laid out in 1939 and 1940 in conifer plantations overtopped by 10- to 16-year-old aspen. Cutting of the aspen in late June was found to be more effective than cutting in either December, April, or August. Five to six years after June cutting, the reduction in stand density amounted to 30 percent on good and 77 percent on poor aspen sites. August cutting was also effective, whereas December and April cuttings were least effective. For both good and poor sites combined, the average height of 5-to 6-year-old aspen sprouts was 4.8 feet when cut in the dormant season and 3.0 feet when cut in summer. Sprouts from the dormant season cutting weighed from four to six times as much as those from the summer cuttings.

The marked reduction in aspen resprouting in the June cuttings is attributed to the fact that reserves of plant food are at a low point shortly after the period of maximum leaf growth. Also it may have some relationship to the availability of growth substances.

A single cutting between late June and early August is usually sufficient to release a plantation. If cuttings are made during the dormant season, aspen and cherry will resprout with maximum vigor and in large numbers; at least two and sometimes three releases may then be needed. The saving by cutting in summer amounts to at least one release requiring one and one-half man-days, or $7 to $8 per acre under present wage scales.

Knowledge of the reaction of aspen to different seasons of cutting is doubly useful. In plantation release where the objective is to get rid of the sprouts, early summer cutting is recommended. The same applies to areas being converted from timber and brush to permanent pasture, or where pastures are mowed occasionally to keep down the aspen and cherry sprouts. On the other hand, if merchantable aspen is clear cut and a second crop is desired from the sprouts and suckers, cutting in the dormant season will provide a new stand of maximum density and vigor.

Management of Northern Hardwoods

How to manage second-growth hardwood farm woodlands is the aim of a study initiated at the Upper Peninsula Experimental Forest during 1946. Farm woods, though small individually, occupy almost one-fourth of the forest area of the Upper Peninsula. Such farm woods are usually made up of second-growth timber of varying age. At present these farm woods contribute little except fuelwood to the owners of the land, and few farmers realize their potential value. Yet with proper management, these woodlands could become an important source of income to the owners.

To demonstrate simple methods of management, 40 acres of "farm woods" were set aside on the Upper Peninsula Experimental Forest near Dukes, Michigan, and cuttings begun. The objectives of this demonstration are (1) to provide accurate information on volume growth and financial

return from annual cuts on second-growth northern hardwoods and (2) to encourage management of small woodlands by the demonstration of good marking principles, practical logging techniques, complete utilization and judicious marketing.

The area selected is a well-stocked tract of northern hardwoods logged over about 35 years ago. There is a scattering of old cull trees, other trees now of size for tie cuts or small sawlogs, and an abundance of poles that have grown up since logging.

The "farm woods" has been divided into five compartments of 8 acres each. One compartment will be cut each year, removing approximately the annual growth for the entire 40-acre tract. Thus the whole tract will be cut over every five years. Marking during the first cutting period has the following aims: (1) remove most defective trees of sawlog size; (2) make a light improvement cutting in pole-sized trees; and (3) salvage merchantable dead and down material.

The returns from the first 5-acre cutting in 1946 were as follows:

Products removed	Net volume	Value at roadside
Sawlogs (woodsrun)	4,350 bd.ft. (Scrib.)	$134.28
Chemical bolts	13.2 cords	89.10
Cordwood	6.3 cords	50.40
Pulpwood	3.4 cords	39.95
Fuelwood (dead wood)	2.0 cords	---
		$313.73

The operator paid $59.40 to have the wood skidded. He spent 208 hours in the woods, making a wage of $1.22 per hour after skidding costs were deducted. The stumpage value of the products removed was $30.02, or all the farmer would have received had he sold similar stumpage in his own farm woods to an outsider, and it would not have been cut as carefully. The great advantage to the farmer of doing his own logging is obvious.

Additional cuttings will be made annually on this forty.

Planted Pine Promises Profit

A 30-year-old red pine plantation near Birch Lake on the Superior National Forest in northern Minnesota was recently studied by the Station. Established on 60 acres of burned-over land in 1915, with 680 transplants per acre, the plantation got off to a good start. Well-stocked portions of the plantation, at the end of 30 growing seasons, had 29 cords of pulpwood and 7 cords of lagging per acre with a stumpage value of $65. If cabin log material were sorted out, the stumpage value could be raised to $71. Costs of planting, release, and reasonable annual charges for taxes, roads, risk, administration, and protection compounded at 3 percent for 30 years amount to $60. A great deal more than this immediate possible profit could be had by making periodic commercial thinnings for pulpwood, lagging, cabin logs, mine timbers, poles and piling, with a final cut of high-quality sawlogs at about 140 years. Nevertheless, it is interesting to note that this plantation already has more than paid its way.

Seed Source Showings

Growth and survival at the end of 16 growing seasons show significant variations among 37 sources of red pine and 20 sources of Scotch pine planted on the Superior National Forest in 1931. Considering survival and growth in height and diameter, the five most promising sources of red pine are from northeastern Minnesota and northwestern Wisconsin. The five poorest sources include one each from northeastern Minnesota, northeastern Wisconsin, Upper Michigan, Lower Michigan, and New Hampshire. On the same basis the best Scotch pine sources are of the central European types (seed collected in central Minnesota, central Wisconsin, and Czechoslovakia) and the poorest include both central and northern European types (seed collected in Iowa, New Hampshire, Norway, Sweden, and Austria). In general the Scotch pine has better survival and diameter growth and about the same height growth as red pine. Injury, especially from insects and porcupines, was much more prevalent in Scotch pine. Form was also much poorer in Scotch pine than in red pine as has been the general experience elsewhere.

Important differences in survival and height growth of various spruces were shown in an 11-year-old planting on the Nicolet National Forest in Wisconsin. Planted in the spring of 1936 were six sources each of Norway spruce and white spruce, two sources of red spruce, and one each of western white spruce, black spruce, Siberian spruce, Sakhalin spruce, Serbian spruce, and Oriental spruce. Considering both survival and height growth, the most promising lots were white spruces from Port Arthur, Douglas, and Angus, Ontario, and Norway spruces from three Russian sources and of variety borealis. Moderately successful were white spruce from the Chippewa and Superior National Forests in Minnesota and the Nicolet National Forest in Wisconsin; Norway spruces from Kilbourn, Wisconsin, and Jugoslavia; Siberian spruce; and Western white spruce. Fair to poor were red spruce from North Carolina, black spruce from northern Minnesota; and Serbian spruce from Jugoslavia. Failures were Sakhalin spruce and red spruce from Pennsylvania. Somewhat alarming was a moderate amount of mortality from a fungus - Armillaria mellea - among some of the largest trees.

Ponderosa pine in North Dakota suffered severe "winter injury" in March, 1946. The least damage occurred to trees of near-local western North Dakota seed sources.

Other Regeneration Results

The severe fire of April 2, 1946, on the Huron National Forest in lower Michigan largely destroyed an experimental block of about 170 acres containing tests of seed source, species, classes of stock, spacings, mixtures, methods of planting and nursery treatments, some of them 15 years old.

FOREST INFLUENCES

Shelterbelt Studies

Which are the more effective, north-south or east-west windbreaks? How does their effectiveness vary with the seasons at five localities distributed over the north to south extent of the prairie-plains region?

These questions were studied with the use of artificial barriers whose density and placement could be controlled. Previously reported have been the effects on wind velocity, including the development of a formula to show the effectiveness of a standard windbreak with wind at different angles. A paper prepared during the past year clarifies the effects which windbreaks and shelterbelts have on temperature conditions and moisture conservation as supported by a study of evaporation from the soil. This paper will be submitted to the Journal of Forestry as the fourth in a series on shelterbelt influences.

COOPERATIVE FARM FORESTRY

Michigan

(In cooperation with Michigan Agricultural Experiment Station)

Improving products and output from small sawmills is the main objective of this project. Good progress was made during 1946 by the development of a lead indicator and of air dogs for small sawmills.

The lead indicator makes it possible to find the lead - the setting of a circular saw at a small angle to clear logs and prevent binding - at which a saw actually runs best, which may be quite different from that given by commonly used rules of thumb.

In addition to being helpful in adjusting lead, this device may be useful in making further studies of saw behavior. In initial tests it has shown that lead requirements vary by species, particularly between hardwoods and softwoods.

Air dogs - mechanical device for holding a log on the carriage and moving it to desired positions - practical for most circular sawmills and small band mills have been developed. They are simple in design, adaptable to a wide variety of headblocks, and low in cost. In contrast, the air dogs previously on the market were quite expensive and designed for high production sawmills principally of the band headrig type.

A test installation was made in a 6-foot band mill with a three-headblock carriage with twin-engine steam feed. Performance has been very satisfactory, and indications are that production is increased 5 to 10 percent over hand dogging with the same crew. Results should be even better for mills in which the sawyer does both setting and dogging.

The man assigned to this project resigned to enter private work at the end of the year.

Wisconsin

(In cooperation with Wisconsin Agricultural Experiment Station and Wisconsin Conservation Department)

This project has pretty well settled the question as to whether timber use or pasture use is preferable for the steeper slopes of southwestern Wisconsin farms. The pasture phase of the study - recently published[1/] - can be summarized briefly as follows: (1) woodland pastures on 15-35 percent slopes produced only one-fifth the forage of open pastures and one-twelfth that of renovated pastures on similar slopes; (2) forage

1/ Journal of Forestry, Vol. 44, 709-711. October, 1946.

produced in the shade of timber was less palatable to livestock than comparable forage from open areas; (3) continued grazing of wooded pastures gives neither economical forage production nor effective land use.

The forestry phase, now ready for publication, concerns (1) the importance, composition, and timber yields of mixed-oak forest stands, (2) recommendations for improving yields, and (3) financial returns possible. Principal findings are: (1) fully stocked oak woodlands produce relatively high yields - up to 180 board feet per acre per year on good sites; (2) under sustained-yield management, even higher yields are possible; (3) while net returns at current prices range up to $6 per acre per year, they are only about one-third of what they could be under good forestry practices; (4) although net returns in dollars per acre are considerably lower than those from agricultural land, the farm woodland makes a valuable and continuous contribution to the entire farm economy by furnishing employment in "off seasons" and "bad years."

Reoriented and broadened, this project now has as one of its principal aims the guiding and interpreting of work on Wisconsin's Timber Harvest Forests. These are essentially demonstration forests used to illustrate suitable methods of managing various types of farm woodlands throughout southern Wisconsin. The Station supervises silvicultural work and will maintain records of growth, yield, and returns. The Wisconsin Agricultural Experiment Station will continue to study grazing effects, and in addition will undertake investigations of pathology and wildlife influences related to forest management. The Conservation Department through purchases of suitable timber tracts furnishes the work areas and cooperates in other ways. The Extension Forester will handle demonstration phases of the project. During 1946, cutting was begun on several Timber Harvest Forests, and the Station began collecting data to bring out the costs and effectiveness of various treatments.

Minnesota

(In cooperation with Minnesota Agricultural Experiment Station)

Work during 1946 was concentrated on the preservative treatment of farm fence posts. The scarcity and high price of durable fence post woods, the high price of present preservative methods and preservatives, and a general lack of information on a readily applicable low cost treatment for farm fence posts emphasize the importance of this problem. The abundance and availability in a large part of Minnesota of nondurable low cost species, such as aspen, paper birch, elm, and black ash, made the problem attractive.

Two lines of work were undertaken. In the first, three of the most promising and least expensive of the recently proposed treating methods were tested on enough posts to determine their practicability. Posts of aspen, jack pine, and paper birch were treated by each of these methods and placed in service tests at the Cloquet Forest Experiment Station and at University Farm. The methods included (a) the so-called Clemson College butt-soaking process, (b) the Oregon State College corrosive sublimate method, and (c) the Osmose treatment. Judging from

the results, only the Clemson College butt-soaking method deserves further trial. This method is very promising on aspen and jack pine, and after a few more tests on additional species now under way, it should be possible to recommend its use.

An entirely new method of treating fence posts and freshly sawn green lumber has been originated on this project. This procedure, tentatively designated as the "dry salting" method, consists of applying a mixture of copper sulphate and sodium dichromate in powder form to the surface of freshly peeled green posts and freshly sawn green lumber. The mixture of these chemicals dissolves in a humid atmosphere and clings to the surface of moist posts and lumber when applied as a powder. This method has some very definite advantages and needs to be more fully investigated. More than 150 posts of aspen, jack pine, and paper birch were treated by this method and placed in service tests during 1946. The method results in deep penetration of the preservative which appears to be firmly fixed in the wood so that it is not readily leached out. A definite advantage of this process over any other now available is that treatment can be concentrated at the ground line and top where more protection against decay is needed. The resulting posts have a very attractive blue color which is not readily leached out, and the tests indicate that the preservative is relatively noncorrosive to staples and wire.

It is planned to try out this process in the field during 1947 to determine its practicability on the farm. Additional tests are also planned on green lumber and on other species, including elm, cottonwood, willow, black ash, and red oak.

FOREST WILDLIFE RESEARCH

(Conducted by Fish and Wildlife Service in Cooperation with the Forest Service)

Wildlife research on forest land continued during 1946 although the three biologists assigned to the Station divided their time between work on Indian lands, national parks, and national forests.

The effects of DDT on vertebrate wildlife were studied in sprayed jack pine plantations on the Nicolet National Forest in Wisconsin. No positive detrimental effects to wildlife were observed.

A study of porcupine damage to forests was started in cooperation with the Denver Research Laboratory. Preliminary observations on the type and extent of damage encountered were made in the three lake states.

The relationship between beaver and timber production in the Littlefork Forest Area (Koochiching County, Minnesota) was studied in cooperation with the Division of Game and Fish of the Minnesota Department of Conservation.

A study of the effect of various rodents on repellent-treated communication wires was started during the year. Both field and cage tests are being tried.

Research on Isle Royale National Park was continued. A summer browse survey on upland vegetation was completed, and a preliminary survey of the beaver food situation was made. These investigations will supply information on management that can be applied to national forest areas.

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No.

246 Treated paper birch and aspen posts give good service.
Harold F. Scholz.

247 Stand changes following light selection cutting.
W. M. Zillgitt.

248 Minnesota woodlot yields valuable crop.
J. R. Neetzel.

249 Slash renoval an important factor in restocking cut-over spruce sw mps. E. I. Roe.

250 Season of cutting affects aspen sprouting.
P. J. Zehngraff.

251 How to improve aspen stocking following summer logging.
Paul J. Zehngraff.

252 Most Lake States lumber now produced by smaller sawmills.
Arthur G. Horn.

253 Cutting immature oak timber sacrifices quality increment.
Harold F. Scholz.

254 Successful jack pine regeneration in Lower Michigan.
Paul O. Rudolf.

255 A quick method of estimating cull in northern hardwood stands.
W. M. Zillgitt.

256 Restocking black spruce swamps by planting.
Eugene I. Roe.

257 Aspen suckers can produce well-stocked mature stands.
Paul J. Zehngraff.

258 The area reforested in the Lake States.
Paul O. Rudolf.

259 Jack pine regeneration retarded by rodents and birds.
Shaler E. Aldous.

260 Jack pine pole supply in Minnesota.
Zigmond A. Zasada.

261 Extended periods of seedfall of white spruce and balsam fir. E. I. Roe.

262 Valuable products can be recovered from No. 2 and poorer logs. W. M. Zillgitt and W. A. Salminen.

263 Thinning young aspen can pay.
Paul J. Zehngraff.

264 A simple accurate scale board for small sawmills.
Richard C. Johnson.

265 Tree species planted in the Lake States.
Paul O. Rudolf.

266 Taper table for aspen (Populus tremuloides) - well-stocked stands. S. R. Gevorkiantz.

267 Lead indicating device for circular sawmill headrigs.
Richard C. Johnson.

268 Yield table for cottonwood plantations.
J. H. Stoeckeler.

269 How many small fence posts to a cord?
Paul J. Zehngraff.

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W. M. Zillgitt.

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3 Estimating cull in northern hardwoods. By W. M. Zillgitt and S. R. Gevorkiantz. 7 pp., mimeo., November 1946.

4 The reforestation job in the Lake States - a new estimate. By Paul O. Rudolf. 9 pp., mimeo., November 1946.

PERSONNEL (December 31, 1946)

Lake States Forest Experiment Station

Administration - Demmon, Elwood L., Director
Roch, Jerry, Administrative Assistant
Devine, Charlotte L., Purchasing Clerk
Woodworth, Helen A., Clerk-Stenographer
Seaman, Mary H., Fiscal Accounting and Auditing Clerk
Miller, Rosemary, Stenographer
Gibney, Adele M., Stenographer

Forest Management - Eyre, Francis H., Silviculturist, In Charge
Rudolf, Paul O., Silviculturist
Gevorkiantz, Suren R., Silviculturist
Olsen, Lucille P., Statistician
Pacuin, Evelyn C., Statistical Clerk

Field Stations

Northern Minnesota Forest Research Center:
Neff, Lawrence P., Forester, In Charge
Zehngraff, Paul J., Silviculturist
Zasada, Zigmond A., Forest Economist
Roe, Eugene I., Silviculturist
Hess, Junior A., Forester
South, Lee S., Timber Management Assistant
Sundquist, Carl E., Clerk

Northern Wisconsin Forest Research Center:
Stoeckeler, Joseph H., Forester, In Charge
Arbogast, Carl Jr., Silviculturist
Condit, Gordon R., Silviculturist
Stoltz, Edward R., Clerk

Experimental Forests and Other Field Stations:

Upper Peninsula, Dukes, Michigan
Zillgitt, Walter M., Silviculturist, In Charge
Engle, LaMont G., Forester
Salminen, Wilho A., Timber Management Assistant

Denbigh, Denbigh, North Dakota (inactive)

Forest Influences - Bates, Carlos G., Silviculturist

Forest Fire Control - Mitchell, J. Alfred, Silviculturist

Forest Economics - Cunningham, Russell N., Forest Economist, In Charge
Keller, Dorothy A., Clerk-Stenographer

Financial Aspects:
Mayne, Howard W., Forest Economist

Forest Survey:
Cunningham, Russell N., Forest Economist
Chase, Clarence D., Forester
Gevorkiantz, Suren R., Silviculturist
White, Henry G., on LWOP subsequent to MTS
Olsen, Lucille P., Statistician
Choate, Grover A., Forester
Seeley, Harvey M., Forester

Cooperative Farm Forestry:
Scholz, Harold F., Silviculturist
French, David W., Agent
Johnson, Richard C., Agent

Products-Supplies:
Horn, Arthur G., Forest Economist
Neetzel, John R., Forester
Sands, Waldo M., Forest Economist
Crosby, John S., Forest Economist
Oldham, Edna D., Clerk-Typist

Forest Biology (Fish and Wildlife Service, U. S. Department of Interior)
Aldous, Shaler E., Biologist
Krefting, Laurits W., Biologist
Gensch, Robert H., Biologist
Houska, Elizabeth K., Clerk-Stenographer